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# (54) METHOD AND APPARATUS FOR VIDEO CAMERA IMAGE FILM SIMULATION

VERFAHREN UND VORRICHTUNG ZUM SIMULIEREN EINER FILMBILDSEQUENZ MIT EINER VIDEOKAMERA

PROCEDE ET DISPOSITIF DE SIMULATION D'UN FILM DE CAMERA VIDEO

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## Description

### Field of the Invention

**[0001]** The present invention relates generally to the field of video camera images. More specifically, the invention provides a method and an apparatus for rendering a video camera image to provide the appearance of a motion-picture-film-recorded image to be output directly for television broadcast or recording on video tape.

### Prior Art

**[0002]** Two basic approaches exist for recording of moving picture images. The first and older process employs photographic film, exposed using a motion picture camera, which is developed and printed to projection film which may then be shown using a projector and screen. Film frame rates for use in cameras and projectors have been standardized at 24 frames per second, which provides the appearance of near continuous motion to the human eye. Thirty frames per second is occasionally employed for films for television. The photographic film and various processing requirements to produce the end product are expensive and require skilled technicians and appropriate facilities for production.

**[0003]** Despite the cost, however, certain attributes of the film process provide an appearance which is aesthetically pleasing and, to some extent, may influence the artistic quality of the recorded images.

**[0004]** The chemical composition of the film and development processes create the "grain" of the film which alters the appearance. Furthermore, contrast of the images on the film varies nonlinearly as a function of light level or exposure. The combination of grain and contrast may be varied by processing techniques and original photographic film composition to provide the desired "look".

**[0005]** The second major process for recording motion pictures is video taping where images are recorded directly on magnetic tape from a television or video camera. Video recording has been designed to conform to standard television formats. In the United States, the basic television broadcast format comprises 525 lines of information, of which approximately 480 lines are displayed on a television screen. Scanning of the entire 525 lines is accomplished 30 times a second. Each television frame of 525 lines is broken into two separate fields of 262 lines and 263 lines. These "even" and "odd" fields are transmitted alternately at 60 fields per second. The lines of the even and odd fields are alternately interleaved to provide the full 525 line frame once every 1/30 second (thirtieth of a second) in a process known as interlacing. Many other standards in the world use 625 lines of information, and interlace 312 and 313 lines at 50 fields per second.

**[0006]** Unlike photographic motion picture film, video recording of images does not contain any grain, and for the most part, the gray scale of the signal of the video camera as recorded on video tape is essentially linear. Noise or "snow" in a video system is typically undesirable, and extensive design engineering is employed to minimize noise from electronic circuits in cameras, recorders and television sets for a clear picture. The flexibility present with photographic film in varying the artistic appearance of the final product by film and process selection is, for the most part, not present with video recording. However, the relative cost of video tape recording is significantly less than photographic film recording. The cost of the photographic film itself, developing and film-to-tape processing significantly exceeds the cost of video tape. On long running times, this cost can be dominant.

**[0007]** The less artistic appearance of video recorded images often results in a decision by producers or directors to use photographic film as opposed to video taping in spite of the above-mentioned advantages. Techniques to enhance the appearance of images recorded on video tape are therefore desirable to provide a combination of the economics of video taping with the desirable appearance of photographic film processes.

**[0008]** Some prior art systems exist which employ a combination of video and film technologies. A system known as "kinescope recording" was developed soon after the advent of television broadcasting to record a program for later rerun that was broadcast live using television cameras. The kinescope system basically recorded the pictures on a television screen using a photographic movie camera, and was rebroadcast by projecting the developed film before a television broadcast camera. To some extent, the kinescope system does add the film attributes when rebroadcast. However, the cost of the photographic film and processing is not eliminated, and the basic system concept inherently provides poor quality of image transfer (poor contrast, lack of detail and geometric distortions).

**[0009]** The second industry standard system, known as the "telecine" system, employs a scanning system to transfer images already recorded on photographic film to video tape. In the telecine system, one frame of film is scanned onto two consecutive video fields with a subsequent frame of film scanned onto three consecutive video fields. The "two-three" sequence is repeated to distribute 24 film frames onto 60 fields of video. Two fields of video are generated for every frame of film if the film is shot at 30 frames-per-second for American television (60 fields-per-second), or for 24 frames-per-second film transferred to a 50 field-per-second standard (typically overseas). This overcomes the basic timing incompatibility of standard photographic movie film and television/video tape. The kinescope lacks this capability. The telecine system does capture the desired film characteristics on the final video tape. However, the initial cost of photographic film and its associated process-

ing is still required.

[0010] A third prior art example allows the use of video cameras and video tape for the initial recording of the movie picture images. The recorded video is then broken down into red, green and blue (RGB) components and scanned onto photographic film. The photographic film is then processed and returned to video tape using the telecine process. Eliminating the need for photographic film cameras provides some savings in this process. However, the cost of scanning equipment for the transfer from video to photographic film is added. The basic cost of the photographic film and its associated processing is also still present.

[0011] A fourth prior art example takes standard video images after they are generated from a video camera or after they are recorded on a video tape and, through inter-field interpolations, creates simulated film "frames" that have durations of two or three fields of video, as described in U.S. Patent No. 4,935,816 issued June 19, 1990 to the inventor of the present application.

[0012] This method does not simulate the exact shutter duration of the film camera at 24 frames-per-second. Motion picture film cameras typically provide exposure durations that are approximately 1/48, 1/50, 1/60 of a second or less. The typical camera has an exposure duration of 1/50 second. This prior art example simulates a shutter speed of approximately 1/30 second.

[0013] In addition, this prior art invention renders simulated film frames that are not evenly spaced in time. The ideal duration from "film frame" to "film frame" is 1/24 second. Because the prior art makes simulated film frames from pairs of video fields that occur 1/30 second apart, and a field is skipped every 5 fields, the timing between simulated film frames alternates between 1/30 second and 1/20 second. The 1/20 second film frame is the 1/30 second field pair, plus the duration of one field (1/60 second).

## Summary of the Invention

[0014] The present invention provides a method and apparatus in accordance with claims 1 and 8 in which a video camera produces a video signal that has the aesthetically desirable appearance of film but with the economy of video technology. The video camera has an imaging device on which a lens forms an image. The imaging device is typically a solid state charge-coupled device (CCD). A circuit provides timing and synchronization for sampling the imaging device to generate an analog-sampled video image in a 24 progressively-scanned frames-per-second format where each frame comprises 625 lines. The sampled analog video image is processed through a video amplifier and converted into a digital-sampled video image by an analog-to-digital converter. A grain simulator provides random noise with filtering which simulates grain pattern imagery. Preferably, the noise is digital pseudorandom. The random noise is added to the digital-sampled video image and modified by a gray scale modifier. The gray scale modifier preferably includes a programmable read-only memory (PROM) for bit mapping the digital-sampled video image onto a gray scale curve reflecting the non-linear characteristics of photographic film. Circuitry is provided for converting the gray scale modified digital-sampled video image into conventional video formats. The conventional video formats typically include either analog or digital 525 lines/60 fields or 625 lines/50 fields video formats. In the present invention, for converting to the 525 lines/60 fields format, a circuit converts the 625-line to a 525-line format by interpolating adjacent lines that have been weighted. Circuitry then converts the 525-line format from progressively-scanned to interlaced-scanned format. A replication of the third field is added after every fourth field. The resulting digital output is in a 525 lines/60 fields format that can be converted to analog by a digital-to-analog converter. For a 625 lines/50 fields output, the gray scale modified digital-sampled video image is converted from progressively-scanned to interlaced-scanned. The resulting output is a digital output in 625 lines/48 fields format. Alternately, this digital output can be transformed by a digital-to-analog converter into an analog output in a 625 lines/48 fields format. Conversion to a 625 lines/50 fields output is accomplished by recording on a video tape recorder operating at approximately a 4% slower speed and playing back the tape at normal speed. An alternate embodiment of the present invention employs a 25 frame per second clocking for direct conversion to 625 lines 50 fields format.

## Brief Description of the Drawings

[0015] The foregoing features of the present invention will be better understood in consideration of the following detailed description of certain preferred embodiments, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic block diagram of the present invention; and

FIG. 2 is a schematic representation of the contrast function for film and video recording.

## Detailed Description

[0016] Referring now to the drawings, FIG. 1 shows a block diagram of the basic elements of the invention.

[0017] An image 102 is focused by a lens 104 onto an imager 106. The imager is typically a solid state charge-coupled device (CCD). However, other imaging devices, such as a pickup tube, may be used. The synchronization and timing controller 108 controls the scanning, timing and outputting of the image signal 110 from the imager 106.

[0018] The image signal 110 is preferably a progressively-scanned video frame. In comparison, a conven-

tional broadcast television camera generates two consecutive interlaced fields. Furthermore, 24 frames-per-second of the image signal are generated to simulate the frame rate of a motion picture camera. Most video standards require 25 or 30 interlaced-scanned frames-per-second. The imager 106 is exposed to light focused from the lens 104, typically for 1/50 second for each progressively-scanned frame.

**[0019]** The image signal 110 may comprise three signals for three images corresponding to the red, green and blue colors. For clarity, FIG. 1 shows the block diagram for one image signal.

**[0020]** The image signal 110 is amplified in a video amplifier 112 and communicated to an analog-to-digital converter 114. The image signal is then converted into a digital-sampled video image 116. The signal processing that subsequently follows in this invention is preferably done in a digital format. However, these processes may also be done in an analog format.

**[0021]** As will be described in greater detail subsequently, a "grain" signal 118 is provided by a grain simulator 120 and added to the digital-sampled video image 116 in a summer 122. The output signal from the summer 122 is modified by the gray scale modifier 124 to transform the video image to reflect the nonlinear characteristics of photographic film. The modified video image 126 from the gray scale modifier has the subjectively pleasing aspect present in photographic film imagery. In the embodiment shown, the gray scale modifier 124 is a non-linear amplifier comprising a PROM that provides a "look up" table for providing the gray scale transformation function. FIG. 2 shows such a gray scale modification function. A normal video gray scale is shown by curve 301 that provides linearly increasing video level with respect to light level exposure, while curve 302 demonstrates a nonlinearly increasing video level with light level characteristic of photographic film image recording. For low level or darker images, the film curve 302 is compressed providing a lower contrast between images of differing light values. The middle of the film curve 302 is expanded and provides an increased contrast between images of differing light values. As with the dark end of the scale, the light end of the film curve is compressed providing lower contrast between images of differing light levels. Because the gray scale modifier is digital, a variety of curves can be stored in the PROM to reflect the gray scale modification curves of differing types of films or to achieve different photographic effects. The desired gray scale modification curve can be selected by depressing an electronic switch (not shown).

**[0022]** The modified video image 126 is a digital video image that has a random noise added to it to simulate the grain of photographic film, and that has been modified to reflect the gray scale nonlinear characteristics of photographic film. This modified video image is in a 24 progressively-scanned frames-per-second format where each frame consists of 625 lines. The image is now converted to a conventional video format. The image could also be converted to other video formats as desired.

**[0023]** For conversion into a 625 lines/48 fields format, the modified video image 126 is inputted into a progressive-to-interlace scan converter 128. The scan converter 128 generates two interlaced fields of 312 and 313 lines each consecutively from the 625 line progressively-scanned frame. The conversion is done in the embodiment shown by storing the video image in a memory, and reading out every other line for the first field and reading the other lines for the second field. The video image is now represented in 48 fields-per-second, each field having 312 or 313 lines. The digital video output 130 in a 625 lines/48 fields format is input directly into a digital video tape recorder 131. The signal 130 is alternatively converted to an analog video output (625 lines/48 fields) 132 by a digital-to-analog converter 134. The analog signal 132 may be recorded directly on an analog video tape recorder 133.

**[0024]** In order to convert the modified video image to a 525 lines/60 fields format, the image is input into a 625-line to 525-line interpolator 136. The conversion from 625 lines to 525 lines is done by combining adjacent lines. For example, to generate an output line $L_0$, the output line may be created by combining adjacent video lines $V_1$, $V_2$, and $V_3$ and multiplying each by a weight factor $W_i$ and summing the three products, i.e., $L_0 = W_1 * V_1 + W_2 * V_2 + W_3 * V_3$. The selection of the number of lines and the weight factors to be applied depends on the desired results. This interpolation is well known to those skilled in the art. For an example of using interpolation in high definition television, see "An HDTV Down Converter for Post Production," <u>SMPTE Journal</u>, February 1990 by Thorpe, Matsumoto & Kuboto. The 525-line video image 138 from the interpolator 136 is converted into an interlace format by progressive-to-interlace scan converter 140. The interlaced output 142 from the converter 140 is a sequence of interlaced fields designated A&B that corresponds to the sequence of frames. However, to achieve a 60 field-per-second format, an adder 144 adds a fifth field that is identical to the third field in a two-frame sequence. For example, if two consecutive frames generate fields A,B, A', B', the adder 144 adds a fifth frame that is identical the third field A'. Thus, the output of adder 144 becomes a 2-3 field sequence of A,B, A', B', A'. This output 146 is in a digital 525 lines/60 fields format that may be recorded on a digital video tape recorder 147. Alternatively, the output 146 can be converted into an analog video output of 525 lines/60 fields format in a digital-to-analog converter 148 for recording on recorder 149.

**[0025]** Video standards such as NTSC, PAL, and SECAM specify line and field rates and include color information encoding. These standards provide composite video signals for luminance and color information together in one signal. The present invention provides individual systems for red, green, and blue channels

(individual components for each primary color). Timing for the system is established for compatibility with the referenced standards. The 24 progressively scanned frames per second employed by the present invention simulates the frame rate of standard movie film cameras. For compatibility, the NTSC standard requires 59.94 fields per second as a field rate for the "standard 525/60" system. Consequently, the present invention operates at 23.976 frames per second to allow 2 interlaced and alternately 3 interlaced fields to be rendered at the required 59.94 fields per second for compatibility with NTSC.

**[0026]** At this frame rate, the 48 field per second output rendered in the 625 line/48 field per second output are actually 47.952 fields per second (2 x 23.976). The PAL standard of 625 lines/50 fields per second is resolved by operating the video tape recorder at 4.096% slower speed thereby altering the 47.952 field per second rate to the exact 50 field per second rate when the tape is played back at normal speed.

**[0027]** In an alternate embodiment targeted for compatibility with the PAL standard, the present invention is operated at 25 progressively scanned frames per second for exact compatibility. In this embodiment recording speed adjustments for the 525/60 video tape recorders 147 and 149 comparable to that previously described are required.

**[0028]** Operation of the present invention at exactly 24 progressively scanned frames per second is employed in a third embodiment wherein recording speed adjustments for both 525/60 and 625/50 standards are accomplished through appropriate control of the digital or analog recorders.

**[0029]** The simulation of film "grain" in the processed video output is accomplished in the present invention through the use of clipped white noise. The "grain" in film-recorded imagery tends to appear as random dark spots on each frame of film. By clipping the positive swing of random white noise, random amplitude negative-going spikes are created. When these spikes are summed into the real-time video signal as the "grain" signal, the sum signal provides an appearance of random dark spots on a picture portion of each line. The grain will not appear as video noise or "snow" which is different for every video field. The grain pattern will be constant for the two or three fields of video that correspond to a single film frame.

**[0030]** Having now described the invention in detail as required by the patent statutes, those skilled in the art will recognize modifications to the embodiments described herein for specific applications. Such modifications, including differing scanning rates or differing lines of the imager and different video outputs, are within the scope of the invention as defined in the following claims.

**Claims**

1. A video camera for generating a video signal to simulate the appearance of film-recorded images comprising: means (106) for receiving a two dimensional optical image using a two dimensional imaging device; means for producing a video signal from the image having a simulated film appearance; means (124) for modifying the video signal image to simulate the nonlinear gray scale of film; characterised in that the producing means includes means for electrically sampling the received two dimensional optical image to generate a sampled video image of 24 progressively-scanned single field frames per second; and means (140) for converting the modified video image into a video image of an interlaced format.

2. A video camera according to Claim 1, characterised in that the video image is an analog video image and the video camera further comprises means (114) for converting the analog-sampled video image into a digital-sampled video image.

3. A video camera according to Claim 1 or to Claim 2, characterised by means for adding clipped white noise for grain simulation to the sampled video image.

4. A video camera of Claim 2, characterised in that the interlaced format is selected from a plurality of output formats.

5. A video camera according to Claim 4, characterised in that said sampling means samples the imaging device to generate an analog-sampled video image in a 24 progressively-scanned frames-per-second format, each frame comprising 625 lines; and further characterised in that said converting means is operable to selectively convert the modified video image into a video image of one of a plurality of second formats, the plurality of second formats including analog 525 lines/60 fields, digital 525 lines/60 fields, analog 625 lines/48 fields, and digital 625 lines/48 fields formats.

6. A video camera according to any one of Claims 1 to 5, characterised in that receiving means (106) comprises a plurality of rows and columns of electric light sensing elements.

7. A video camera according to any one of Claims 1 to 5, characterised in that said receiving means (106) comprises a charge coupled device.

8. A method for generating a video signal to simulate the appearance of film-recorded images comprising the steps of: capturing a two dimensional optical

image on a two dimensional imagining device; processing the received optical image to provide a simulated film image video signal; modifying the video signal to simulate the nonlinear gray scale of film; characterised in that the processing step comprises electrically sampling the captured two dimensional optical image; and generating a sample video image of 24 progressively-scanned single field frames per second from the sampled optical image; and converting the modified video image into a video image of an interlaced format.

9. A method according to Claim 8, characterised by the steps of generating an analog-sampled video image and converting the sampled analog video image into a digital-sampled video image.

10. A method according to Claim 8, characterised by the step of adding clipped white noise for grain simulation to the sampled video image.

11. A video camera according to claims 1 to 7, characterised in that each frame of the sampled image comprises 625 lines.

12. A method according to claims 8 to 10, characterised in that each frame of the sampled image comprises 625 lines.

13. A video camera according to Claim 11, as dependent upon Claim 1, characterised in that the converting means comprises: means for converting each frame of sampled video image into a 525 line format; means for converting the video image from a progressively-scanned format into an interlaced-scanned format, the interlaced-scanned format having four fields; means (144) for adding a fifth field, identical to the third field, to the video image after the fourth field; and means for outputting the five-field video image.

14. A video camera according to Claim 6, characterised in that the converting means further comprises means (148) for converting the five-field video image into an analog five-field video image.

15. A video camera according to Claim 11, as dependent upon Claim 1, characterised in that the converting means comprises: means for converting the video image from a progressively-scanned format into an interlaced-scanned format, the interlaced-scanned format having four fields; and means for outputting the four-field video image.

16. A video camera according to Claim 15, characterised in that the converting means further comprises means for converting the four-field video image into an analog four-field video image.

17. A video camera according to claims 1 to 7, 11, 13 to 16, characterised in that the interlaced format comprises, an analog 525 lines/60 fields format; a digital 525 lines/60 fields format; an analog 625 lines/48 fields format; or a digital 625 lines/48 fields format.

18. A method according to claims 8 to 10, 12, characterized in that the interlaced format comprises an analog 525 lines/60 fields format; a digital 525 lines/60 fields format; an analog 625 lines/48 fields format; or a digital 625 lines 48 fields format.

19. A videosystem including a camera according to any one of Claims 1 to 7, characterised by means (133, 149) for recording the video image, said recording means having adjustable record and play-back speeds.

## Patentansprüche

1. Videokamera zum Erzeugen eines Videosignales zum Simulieren des Aussehens von auf einem Film aufgezeichneten Bildern, mit:

einer Einrichtung (106) zum Empfangen eines zweidimensionalen optischen Bildes unter Verwendung einer zweidimensionalen Abbildungsvorrichtung, einer Einrichtung zum Erzeugen eines Videosignales aus dem Bild mit dem simulierten Aussehen eines Films, einer Einrichtung (124) zum Modifizieren des Videosignalbildes zum Simulieren einer nichtlinearen Grauabstufung des Films,
dadurch gekennzeichnet, dass die Erzeugungseinrichtung eine Einrichtung zum elektrischen Abtasten des empfangenen, zweidimensionalen optischen Bildes beinhaltet, um ein abgetastetes Videobild aus 24 progressiv abgetasteten Einzel-Teilbild-Vollbildern pro Sekunde zu erzeugen, und einer Einrichtung (140) zum Umwandeln des modifizierten Videobildes in ein Videobild eines verschachtelten Formats.

2. Videokamera nach Anspruch 1,

dadurch gekennzeichnet, dass das Videobild ein analoges Videobild ist und die Videokamera weiterhin eine Einrichtung (114) zum Umwandeln des analog abgerasteten Videobildes in ein digital abgetastetes Videobild umfasst.

3. Videokamera nach Anspruch 1 oder Anspruch 2,

gekennzeichnet durch eine Einrichtung zum Hinzufügen begrenzten weißen Rauschens zur

Rausch-Simulation des abgetasteten Videobildes.

4. Videokamera nach Anspruch 2,

dadurch gekennzeichnet, dass das verschachtelte Format aus einer Mehrzahl von Ausgabeformaten ausgewählt ist.

5. Videokamera nach Anspruch 4,

dadurch gekennzeichnet, dass die Abtasteinrichtung die Abbildungsvorrichtung abtastet, um ein analog abgetastetes Videobild in einem progressiv abgetasteten 24 Vollbilder-Pro-Sekunde-Format zu erzeugen, wobei jedes Vollbild 625 Zeilen umfasst; und weiterhin dadurch gekennzeichnet, dass die Umwandlungseinrichtung das modifizierte Videobild selektiv in ein Videobild aus einem aus einer Mehrzahl von zweiten Formaten umwandelt, wobei die Mehrzahl von zweiten Formaten analog 525 Zeilen/60 Teilbilder-, digital 525 Zeilen/60 Teilbilder-, analog 625 Zeilen/48 Teilbilder- und digital 625 Zeilen/48 Teilbilder-Formate beinhaltet.

6. Videokamera nach einem der Ansprüche 1 bis 5,

dadurch gekennzeichnet, dass die Empfangseinrichtung (106) eine Mehrzahl von Zeilen und Spalten elektrischer Lichterfassungselemente umfasst.

7. Videokamera nach einem der Ansprüche 1 bis 5,

dadurch gekennzeichnet, dass die Empfangseinrichtung (106) eine ladungsgekoppelte Vorrichtung umfasst.

8. Verfahren zum Erzeugen eines Videosignals zum Simulieren des Aussehens eines auf einem Film aufgezeichneten Bildes mit den Schritten:

Erfassen eines zweidimensionalen optischen Bildes auf einer zweidimensionalen Abbildungsvorrichtung, Verarbeiten des empfangenen optischen Bildes zum Bereitstellen eines simulierten Filmbild-Videosignals, Modifizieren des Videosignals zum Simulieren der nichtlinearen Grauabstufung eines Films,
dadurch gekennzeichnet, dass der Verarbeitungsschritt ein elektrisches Abtasten des erfassten zweidimensionalen optischen Bildes umfasst, und erzeugen eines Abtast-Videobildes aus 24 progressiv abgetasteten Einzel-Teilbild-Vollbildern pro Sekunde aus dem abgerasteten optischen Bild und Umwandeln des modifizierten Videobildes in ein Videobild in einem verschachtelten Format.

9. Verfahren nach Anspruch 8,

gekennzeichnet durch die Schritte der Erzeugung eines analog abgetasteten Videobildes und Umwandeln des abgetasteten analogen Videobildes in ein digital abgetastetes Videobild.

10. Verfahren nach Anspruch 8, gekennzeichnet durch den Schritt des Hinzufügens begrenzten weißen Rauschens zur Rausch-Simulation des abgetasteten Videobildes.

11. Videokamera nach Anspruch 1 bis 7,

dadurch gekennzeichnet, dass jedes Vollbild des abgetasteten Bildes 625 Zeilen umfasst.

12. Verfahren nach Anspruch 8 bis 10,

dadurch gekennzeichnet, dass jedes Vollbild des abgetasteten Bildes 625 Zeilen umfasst.

13. Videokamera nach Anspruch 11, auf der Basis von Anspruch 1,

dadurch gekennzeichnet, dass die Umwandlungseinrichtung umfasst: eine Einrichtung zum Umwandeln jedes Vollbildes eines abgetasteten Videobildes in ein 525-Zeilen-Format, eine Einrichtung zum Umwandeln des Videobildes von einem progressiv abgetasteten Format in ein verschachtelt abgetastetes Format, wobei das verschachtelt abgetastete Format vier Teilbilder aufweist, eine Einrichtung (144) zum Hinzufügen eines fünften Teilbildes, welches mit dem dritten Teilbild identisch ist, zu dem Videobild nach dem vierten Teilbild, und eine Einrichtung zum Ausgeben des Fünf-Teilbild-Videobildes.

14. Videokamera nach Anspruch 6,

dadurch gekennzeichnet, dass die Umwandlungseinrichtung weiterhin eine Einrichtung (148) umfasst zum Umwandeln des Fünf-Teilbild-Videobildes in ein analoges Fünf-Teilbild-Videobild.

15. Videokamera nach Anspruch 11, auf der Basis von Anspruch 1,

dadurch gekennzeichnet, dass die Umwandlungseinrichtung umfasst: eine Einrichtung zum Umwandeln des Videobildes aus einem

progressiv abgetasteten Format in ein verschachtelt abgetastetes Format, wobei das verschachtelt abgetastete Format vier Teilbilder aufweist, und eine Einrichtung zum Ausgeben des Vier-Teilbild-Videobildes.

**16.** Videokamera nach Anspruch 15,

dadurch gekennzeichnet, dass die Umwandlungseinrichtung weiterhin eine Einrichtung zum Umwandeln des Vier-Teilbild-Videobildes in ein analoges Vier-Teilbild-Videobild umfasst.

**17.** Videokamera nach Anspruch 1 bis 7, 11, 13 bis 16,

dadurch gekennzeichnet, dass das verschachtelte Format umfasst ein analoges 525 Zeilen/60 Teilbilder-Format, ein digitales 525 Zeilen/60 Teilbilder-Format, ein analoges 625 Zeilen/48 Teilbilder-Format oder ein digitales 625 Zeilen/48 Teilbilder-Format.

**18.** Verfahren nach Anspruch 8 bis 10, 12,

dadurch gekennzeichnet, dass das verschachtelte Format ein analoges 525 Zeilen/60 Teilbilder-Format umfasst, ein digitales 525 Zeilen/60 Teilbilder-Format, ein analoges 625 Zeilen/48 Teilbilder-Format oder ein digitales 625 Zeilen/48 Teilbilder-Format.

**19.** Videosystem, mit einer Kamera gemäß einem der Ansprüche 1 bis 7,

gekennzeichnet durch eine Einrichtung (133, 149) zum Aufzeichnen des Videobildes, wobei die Aufzeichnungseinrichtung einstellbare Aufzeichnungs- und Wiedergabe-Geschwindigkeiten aufweist.

**Revendications**

**1.** Caméra vidéo destinée à générer un signal vidéo pour simuler l'apparence d'images de film enregistré, comportant :

un moyen (106) de réception d'une image optique bidimensionnelle utilisant un dispositif de visualisation bidimensionnel; un moyen de production d'un signal vidéo à partir de l'image qui a l'apparence d'un film simulé ; un moyen (124) de modification de l'image du signal vidéo pour simuler l'échelle non-linéaire des niveaux de gris d'un film ; caractérisée en ce que le moyen de production comprend un moyen pour échantillonner électriquement l'image optique bidmensionnelle reçue afin de générer une image vidéo échantillonnée de 24 images à trame unique et sans entrelacement par seconde ; et un moyen (140) pour convertir l'image vidéo modifiée en une image vidéo de format entrelacé.

**2.** Caméra vidéo selon la revendication 1, caractérisée en ce que l'image vidéo est une image vidéo analogique, et que la caméra vidéo comporte en outre un moyen (114) de conversion d'image vidéo échantillonnée analogique en image vidéo échantillonnée numérique.

**3.** Caméra vidéo selon la revendication 1 ou la revendication 2, caractérisée par un moyen pour ajouter un bruit blanc écrêté pour simuler un grain sur l'image vidéo échantillonnée

**4.** Caméra vidéo de la revendication 2 , caractérisée en ce que le format entrelacé est choisi parmi une pluralité de formats de sortie.

**5.** Caméra vidéo selon la revendication 4, caractérisée en ce que ledit moyen d'échantillonnage échantillonne le dispositif de visualisation pour générer une image vidéo échantillonnée analogique de format 24 trames par seconde sans entrelacement, chaque trame comportant 625 lignes ;et caractérisée en outre en ce que ledit moyen de conversion est prévu pour convertir sélectivement l'image vidéo modifiée en une image vidéo dans un d'une pluralité de deuxièmes formats, la pluralité de deuxième formats comprenant un format analogique de 525 lignes /60 trames, un format numérique de 525 lignes /60 trames , un format analogique de 625 lignes/48 trames , et un format numérique 625 lignes / 48 trames.

**6.** Caméra vidéo selon l'une quelconque des revendications 1 à 5, caractérisée en ce que le moyen de réception (106) comporte une pluralité de rangées et de colonnes d'éléments électriques photosensibles.

**7.** Caméra vidéo selon l'une quelconque des revendications 1 à 6, caractérisée en ce que ledit moyen de réception (106) comprend un circuit à couplage de charges.

**8.** Procédé de génération d'un signal vidéo pour simuler l'apparence d'images de film enregistré, comportant les étapes:

de captage d'une image optique bidimensionnelle sur un dispositif bidimensionnel de visualisation ; de traitement de l'image optique reçue pour générer un signal d'image vidéo de film simulé ; et de modification du signal vidéo pour simuler l'échelle non-linéaire des niveaux de

gris de film ; caractérisé en ce que l'étape de traitement comporte l'échantillonnage électrique de l'image optique captée bidimensionnelle ; de génération à partir de l'image optique échantillonnée d'une image vidéo de 24 trames sans entrelacement par seconde ; et de conversion de l'image vidéo modifiée en un image vidéo de format entrelacé.

9. Procédé selon la revendication 8, caractérisé par les étapes de génération d'une image vidéo analogique échantillonnée et de conversion de l'image vidéo échantillonnée analogique en une image vidéo échantillonnée numérique.

10. Procédé selon la revendication 8, caractérisé par l'étape de rajout de bruit blanc écrêté pour simuler un l'étape de rajout de bruit blanc écrêté pour simuler un grain sur l'image vidéo échantillonnée.

11. Caméra vidéo selon les revendications 1 à 7, caractérisée en ce que chaque trame de l'image échantillonnée comporte 625 lignes.

12. Procédé selon les revendications 8 à 10, caractérisé en ce que chaque trame de l'image échantillonnée comporte 625 lignes.

13. Caméra vidéo selon la revendication 11, dans la mesure où elle dépend de la revendication 1, caractérisée en ce que le moyen de conversion comporte : un moyen de conversion de chaque trame d'image vidéo échantillonnée en un format de 525 lignes ; un moyen de conversion de l'image vidéo de format non-entrelacé en un format à balayage entrelacé, le format entrelacé comportant quatre trames ; un moyen (144) de rajout d'une cinquième trame, identique à la troisième trame, à l'image vidéo après la quatrième trame ; et un moyen pour générer en sortie une image vidéo à cinq trames.

14. Caméra vidéo selon la revendication 6, caractérisée en ce que le moyen de conversion comporte en outre un moyen (148) de conversion de l'image vidéo à cinq trames en une image vidéo analogique à cinq trames.

15. Caméra vidéo à selon la revendication 11, dans la mesure où elle dépend de la revendication 1, caractérisée en ce que le moyen de conversion comporte : un moyen pour convertir l'image vidéo de format non-entrelacé en un format à balayage entrelacé, le format à balayage entrelacé ayant quatre trames ; et un moyen pour générer en sortie l'image vidéo à quatre trames.

16. Caméra vidéo selon la revendication 15, caractérisée en ce que le moyen de conversion comporte en outre un moyen pour convertir l'image vidéo à quatre trames en une image vidéo analogique à quatre trames.

17. Caméra vidéo selon l'une quelconque des revendications 1 à 7, 11, 13 à 16, caractérisée en ce que le format entrelacé comprend un format analogique de 525 lignes /60 trames ; un format numérique de 525 lignes /60 trames ; un format analogique 625 lignes/ 48 trames ; ou un format numérique 625 lignes /48 trames.

18. Procédé selon les revendications 8 à 10, 12, caractérisé en ce que le format entrelacé comprend un format analogique de 525 lignes /60 trames ; un format numérique de 525 lignes/ 60 trames; un format analogique de 625 lignes/48 trames ; ou un format numérique de 625 lignes/ 48 trames.

19. Système vidéo comprenant une caméra selon l'une quelconque des revendications 1 à 7, caractérisé par un moyen (133, 149) d'enregistrement de l'image vidéo, ledit moyen d'enregistrement ayant des vitesses réglables d'enregistrement et de lecture.

Fig. 1

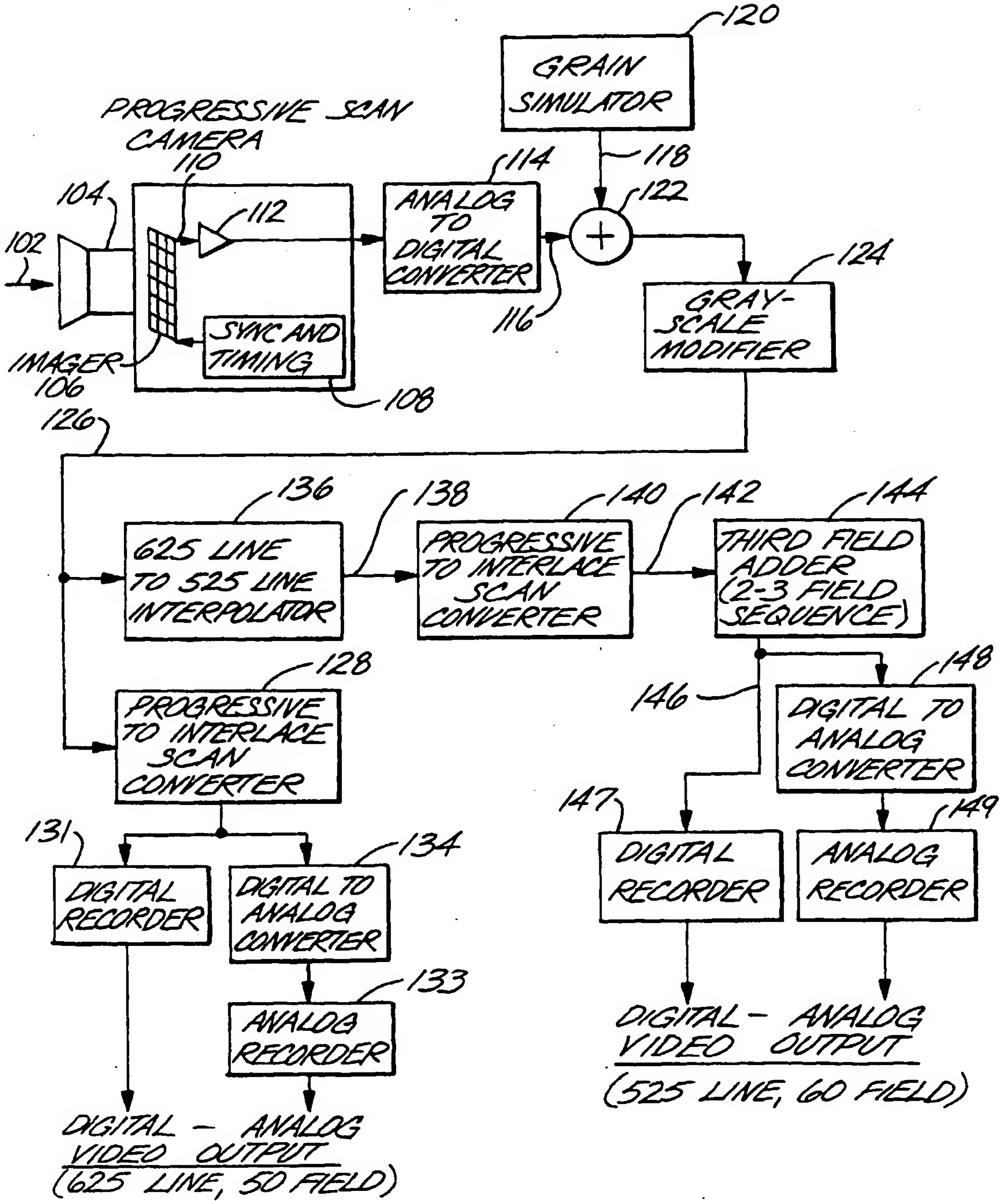
120
GRAIN SIMULATOR
PROGRESSIVE SCAN CAMERA
110
114
118
104
122
112
102
ANALOG TO DIGITAL CONVERTER
124
GRAY-SCALE MODIFIER
116
SYNC AND TIMING
IMAGER 106
108
126
136
138
140
142
144
625 LINE TO 525 LINE INTERPOLATOR
PROGRESSIVE TO INTERLACE SCAN CONVERTER
THIRD FIELD ADDER (2-3 FIELD SEQUENCE)
128
148
146
PROGRESSIVE TO INTERLACE SCAN CONVERTER
DIGITAL TO ANALOG CONVERTER
147
149
131
134
DIGITAL RECORDER
ANALOG RECORDER
DIGITAL RECORDER
DIGITAL TO ANALOG CONVERTER
133
ANALOG RECORDER
DIGITAL - ANALOG VIDEO OUTPUT (525 LINE, 60 FIELD)
DIGITAL - ANALOG VIDEO OUTPUT (625 LINE, 50 FIELD)

Fig. 2

GRAY-SCALE MODIFICATION